MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2019/2020

TES3141 – EXPERT SYSTEMS
(All Sections / Groups)

22 OCTOBER 2019
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This question paper consists of 6 pages with 4 questions only.
2. Attempt **ALL** questions. All questions carry equal marks and the distribution of the marks for each question is given.
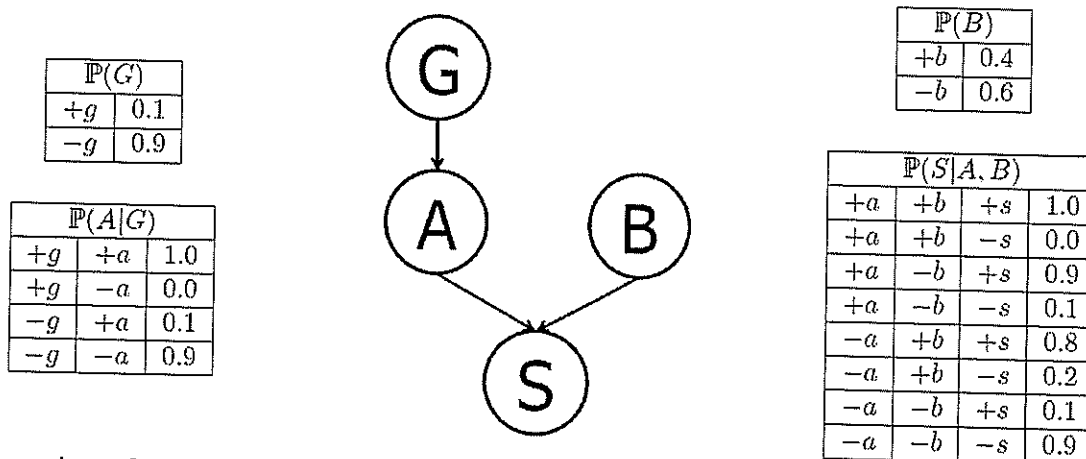3. Please write all your answers in the Answer Booklet provided.

QUESTION 1

(a) Compare deductive reasoning and inductive reasoning. Provide an example for each of them.

[4 marks]

(b) Two sentences are logically equivalent if and only if they have the same truth value. Thus, if A and B are any statements, the biconditional statement,

A↔B, or the equivalence, A≡B

will be TRUE in every case, giving a tautology.

Determine if the sentences below are logically equivalent by writing them using logical symbols and determine if the truth table of their biconditional is a tautology.

If you eat durian, then you cannot drink Coke.
If you drink Coke, then you cannot eat durian.

[3 marks]

(c) Suppose that a patient can have a symptom (S) that can be caused by two different diseases (A and B). It is known that the variation of gene G plays a big role in the manifestation of disease A. The Bayes' Net and corresponding conditional probability tables for this situation are shown below.

$\mathbb{P}(G)$	
$+g$	0.1
$-g$	0.9

$\mathbb{P}(A|G)$		
$+g$	$+a$	1.0
$+g$	$-a$	0.0
$-g$	$+a$	0.1
$-g$	$-a$	0.9

$\mathbb{P}(B)$	
$+b$	0.4
$-b$	0.6

$\mathbb{P}(S|A,B)$			
$+a$	$+b$	$+s$	1.0
$+a$	$+b$	$-s$	0.0
$+a$	$-b$	$+s$	0.9
$+a$	$-b$	$-s$	0.1
$-a$	$+b$	$+s$	0.8
$-a$	$+b$	$-s$	0.2
$-a$	$-b$	$+s$	0.1
$-a$	$-b$	$-s$	0.9

  i.   Compute $P(+g, +a, +b, +s)$ from the joint distribution.
  ii.   What is the probability that a patient has disease A?
  iii.   What is the probability that a patient has the disease carrying gene variation G given that they have disease A?

[1+1+1 marks]

Continued...

QUESTION 2

(a) Draw a frame system for mobile phones. Consider their characteristics like name, manufacturer, operating systems, specialization (a-kind-of / is-a), and owner. Include one instance with filled slots.
[4 marks]

(b) Given the training data below:

Example No.	Color	Type	Origin	Stolen?
1	Red	Sports	Domestic	Yes
2	Red	Sports	Domestic	No
3	Red	Sports	Domestic	Yes
4	Yellow	Sports	Domestic	No
5	Yellow	Sports	Imported	Yes
6	Yellow	SUV	Imported	No
7	Yellow	SUV	Imported	Yes
8	Yellow	SUV	Domestic	No
9	Red	SUV	Imported	No
10	Red	Sports	Imported	Yes

i.   Calculate the following quantities:
[Note: You do not need to convert the answers to decimals]

P(Stolen=Yes)	
P(Stolen=No)	

P(Color|Stolen)	Stolen=Yes	Stolen=No
P(Color=Red|Stolen)		
P(Color=Yellow|Stolen)		

P(Type|Stolen)	Stolen=Yes	Stolen=No
P(Type=Sports|Stolen)		
P(Type=SUV|Stolen)		

P(Origin|Stolen)	Stolen=Yes	Stolen=No
P(Origin=Domestic|Stolen)		
P(Origin=Imported|Stolen)		

ii. Given a Red SUV Domestic car, classify whether it will be stolen using Naïve Bayes method. [Note: You do not need to convert the answers to decimals]
[3.5 + 2.5 marks]

Continued...

QUESTION 3

(a) The new Josh Bond Movie (M), Skyrise, is premiering later this week. Skyrise will either be great (+m) or horrendous (-m); there are no other possible outcomes for its quality. Since you are going to watch the movie no matter what, your primary choice is between going to the theater (theater) or renting (rent) the movie later. Your utility of enjoyment is only affected by these two variables as shown below:
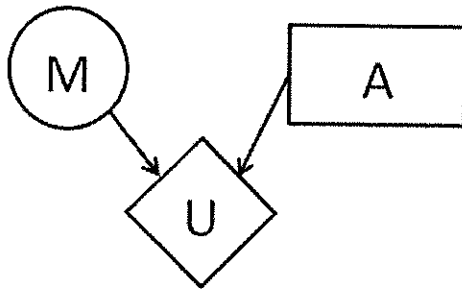
M	P(M)
+m	0.5
-m	0.5

M	A	U(M,A)
+m	theater	100
-m	theater	10
+m	rent	80
-m	rent	40

Compute the following quantities:

    i. $EU(theater)$
   ii. $EU(rent)$
  iii. $MEU(\{\})$
  iv.   Which action achieves $MEU(\{\})$?

[1+1+1+1 marks]

(b) Study the following information carefully.

IF	sky is clear
AND	the forecast is sunny
THEN	the action is "wear sunglasses" CF = 0.7

Assuming that

CF (sky is clear)   = 0.8
CF (the forecast is sunny) = 0.6

Calculate CF(the action is "wear sunglasses").

[1 mark]

Continued...

(c) Study the following information carefully.

IF   sky is overcast
OR   the forecast is rain
THEN   the action is "take an umbrella" $CF = 0.9$

Assuming that

CF (sky is overcast) = 0.7
CF (the forecast is rain) = 0.8

Calculate CF(the action is "take an umbrella").   [1 mark]

(d) Given the following information:

IF   A is X
THEN C is Z
$CF_{rule1} = 0.8$

IF   B is Y
THEN C is Z
$CF_{rule2} = 0.6$

Assuming that

CF (A is X)   = 0.9
CF (B is Y)   = -0.7

Calculate $CF_{combined}(CF_{rule1}, CF_{rule2})$. Justify your answer based on the certainty factors.   [4 marks]

Continued...

QUESTION 4

Given the rules:

Rule 1: IF *do revision* THEN *pass exam*.
Rule 2: IF *do revision* THEN *fail exam*.

and assuming that:

p = pass exam
f = fail exam
$\Theta = \{p, f\}$
$m_1(p) = 0.8$ $m_1(\Theta) = 0.2$ for Rule 1
$m_2(f) = 0.4$ $m_2(\Theta) = 0.6$ for Rule 2

(a) Produce the Dempster-Shafer table showing the combination of evidence.
                                                                              [2 marks]
(b) Calculate the combined mass (before normalization).   [1.5 marks]
(c) Calculate κ.   [2 marks]
(d) Calculate the combined mass (after normalization).   [1.5 marks]
(e) Calculate the combined belief function.   [1 mark]
(f) Calculate the plausibilities.   [1 mark]
(g) Calculate the evidential intervals.   [1 mark]

End of Paper